SPECIFICATION

SLASHER

BACKGROUND OF THE INVENTON

Field of the Invention

The present invention relates to a slasher for applying size to warp yarns and, more particularly, to a slasher provided with a moisture control means for properly controlling the moisture percentage of warp yarns.

Description of the Related Art

A conventional slasher is provided with a moistening device for moistening warp yarns before sizing the warp yarns. Moistening the warp yarns before sizing increases the effect of sizing subsequent to moistening and hence the necessary amount of the size can be reduced. The moistening device immerses warp yarns in water contained in a water tank and squeezes the warp yarns with squeeze rollers. When the warp yarns are thus squeezed with the squeeze rollers, moisture infiltrates fibers and moisture diffuses from parts having high moisture percentages to parts having low moisture percentages in the warp yarns, so that the entire warp yarns is moistened uniformly and excessive moisture is removed. Since the warp yarns are thus properly moistened at a moisture percentage, the warp yarns are sized at a fixed size percentage.

The moisture percentage (%) of the warp yarn and the size percentage (%) of the warp yarn are defined by the following expressions.

(Moisture percentage) = {(Weight of moisture)/(Weight of yarn)} × 100 (%)

(Size percentage) = {(Weight of size)/(Weight of yarn)} × 100 (%)

This conventional slasher passes the warp yarns through water in the water tank. Therefore, warp yarns of some kind retain water excessively even though the warp is squeezed with the squeeze rollers and the slasher is unable to provide a warp moistened at a proper moisture percentage. A warp of some type of yarns, such as cotton/rayon blended yarns or 100% polyester spun yarns, cannot be reduced to a proper moisture percentage even if a maximum squeezing pressure that can be exerted by the slasher is applied to the warp. When a warp of some type of yarns is subjected to a squeezing process, the strength of the warp yarns is reduced, fluffs are formed in the warp yarns or the degree of connection of the component fibers of the warp yarn is reduced and the quality of the warp yarns is deteriorated. Therefore, a high squeezing pressure cannot be applied to the warp even if the squeezing pressure is lower than the maximum squeezing pressure.

If the warp holds an excessive amount of water, the warp is sized at an excessively low size percentage by a sizing

process. In the sizing process, moisture moistening the warp is replaced and mixed with size liquor and the size liquor is held with the warp. The size liquor picked up by the warp is diluted with the moisture moistening the warp. Therefore, if the warp holds an excessive amount of water, the size liquor picked up by the warp is diluted excessively and the warp holding the size liquor is squeezed. Consequently, the warp is sized at an excessively low size percentage.

If the warp holding an excessive amount of water is subjected to the sizing process, the size liquor is diluted rapidly with the water held on the warp and it is difficult to maintain the size liquor in a sizing tank at a predetermined size concentration by replenishing the sizing tank with a new size and, consequently, it is difficult to size the warp uniformly at a proper size percentage.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a slasher, which sizes warp yarns after moistening the same, to be capable of moistening the warp at a proper moisture percentage.

According to the present invention, warp yarns is moistened by sprinkling water on the warp. The warps absorb all or part of the water sprinkled on the warp and become moistened. Since the warp yarns are not immersed in water

contained in a vessel, the warps are not moistened excessively. Even if the warp yarns are moistened irregularly, the moisture moistening the warp yarns diffuses uniformly over the warp and infiltrates the warp yarns when the moistened warp yarns are squeezed. The moisture moistening the warp yarns is replaced and mixed with the size liquor when the warp yarns are passed through the size liquor and are squeezed. Thus, the moisture infiltrates the warp yarns and the size liquor is able to infiltrate the warp yarns satisfactorily.

According to one aspect of the present invention, a slasher comprises: a moistening unit for moistening warp yarns by sprinkling water on the warp; a squeezing unit for squeezing the moistened warp; and a sizing unit for sizing the moistened and squeezed warp.

Preferably, the moistening unit adjusts water sprinkling rate at which water sprinkled the warp yarns according to operating conditions.

Preferably, the moistening unit sprinkles water on warp yarns by spraying water through nozzles on the warp yarns.

Preferably, the moistening unit includes a plurality of nozzle groups each having a plurality of nozzles arranged along width of the warp yarns, and the nozzle groups are controlled individually.

Preferably, the nozzles of each of the nozzle groups of the moistening unit are arranged at intervals different from

those at which the nozzles of the other nozzle group are arranged, and water is supplied at different pressures to the nozzle groups, respectively.

Preferably, the one or plural nozzles are movable toward and away from the warp yarns.

Preferably, the moistening unit includes a movable moistening adjusting member disposed between the one or plural nozzles and the warp yarns.

Preferably, the moistening unit sprinkles hot water on the warp yarns.

Since the moistening unit sprinkles the warp yarns with water to moisten the warp yarns, the warp yarns absorb all or part of the water sprinkled thereon and is moistened. The warp yarns are not immersed in water contained in a vessel and hence the warp yarns are not excessively moistened. Since the squeezing unit squeezes the moistened the warp yarns, even if the warp yarns are irregularly moistened, moisture diffuses from parts having high moisture percentages to parts having low moisture percentages in the warp when the warp yarns are squeezed, so that the warp yarns are moistened uniformly and moisture infiltrates the warp yarns satisfactorily. When the sizing unit sizes the moistened the warp yarns, the moisture moistening the warp yarns is replaced and mixed with the size liquor, so that the size liquor is able to infiltrate the warp yarns satisfactorily.

In the slasher according to the present invention, the moistening unit may adjust water-sprinkling at which water is sprinkled on the warp yarns according to operating conditions.

Since the moistening unit adjusts water-sprinkling rate according to operating conditions, water is sprayed properly according to operating conditions including the number, the type, the yarn number count and the moving speed of the warp yarns, so that the warp yarns are moistened properly.

In the slasher according to the present invention, the moistening unit may sprinkle water on warp yarns by spraying water through one or plural nozzles.

Since water is sprayed in small droplets by a spraying pressure so that the droplets fly at high speeds, the warp yarns can be moistened efficiently and uniformly by spraying water at a low sprinkling rate.

In the slasher according to the present invention, the moistening unit may include a plurality of nozzle groups each having a plurality of nozzles arranged along the width of the warp yarns, and the nozzle groups may be controlled individually.

The optimum one of the plurality of nozzle groups can be selectively used according to operating conditions.

In the slasher according to the present invention, the nozzles of each of the nozzle groups of the moistening unit may be arranged at intervals different from those at which the

nozzles of the other nozzle group are arranged, and water may be supplied at different pressures to the nozzle groups, respectively.

Thus, even if the pressure of the water supplied to the moistening unit is changed according to operating conditions, by changing nozzle group which sprays water spraying ranges in which the nozzles spray water do not overlap excessively and no part of the warp yarns is not moistened.

In the slasher according to the present invention, the one or plural nozzles may be movable toward and away from the warp yarns.

Thus, the spraying ranges of the nozzles can be adjusted and the warp of the warp yarns can be uniformly moistened.

In the slasher according to the present invention, the moistening unit may include a movable moistening adjusting member disposed between the one or plural nozzles and the warp yarns.

Thus, the amount of water sprayed on the warp yarns can be adjusted according to operating conditions.

In the slasher according to the present invention, the moistening unit may sprinkle hot water on the warp.

Hot water is capable of infiltrating the warp yarns more easily, and more moisture evaporates from the surfaces of the warp yarns before the warp yarns reaches the sizing unit because the warp yarns moistened with hot water become high in

temperature. Consequently, the warp yarns is not moistened excessively.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a schematic side elevation of a slasher in a preferred embodiment according to the present invention;

Fig. 2 is a schematic plan view of warp yarns of assistance in explaining a spraying range;

Fig. 3 is a schematic side elevation of movable nozzle;

Fig. 4 is a schematic side elevation of movable nozzle; and

Fig. 5 is a schematic side elevation of a moistening unit and a squeezing device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figs. 1 and 2, a slasher 1 in a preferred embodiment according to the present invention for sizing warp yarns 2 includes a moistening unit 3, a squeezing unit 4, a known sizing unit 5 and a known drying unit. The warps 2 sized by the known sizing unit 5 are delivered to the known drying unit 6.

Generally, the slasher 1 is operated in a low-speed mode for knoting broken warp yarns or in a normal mode for a sizing operation. The moistening unit 3 sprays water 7 from above the warp yarns 2 to moisten the warp yarns 2. Water 7 is supplied from a high pressure water source 8 through two line which are composed of a first line 9 to a plurality of first nozzles 14 for spraying water 7 during sizing operation in the low-speed mode and a second line 9 to a plurality of second nozzles 15 for spraying water 7 during operation in the normal mode. The first line 9 is provided with a solenoid valve 10 and a flow control valve 12. The second line 9 is provided with a solenoid valve 11 and a flow control valve 13. A spraying operation controller 16 controls the solenoid valves 10 and 11. The spraying operation controller 16 opens the solenoid valve 10 and closes the solenoid valve 11 for operation in the low-speed mode. The spraying operation controller 16 closes the solenoid valve 10 and opens the solenoid valve 11 for operation in the normal mode.

The plurality of nozzles 14 and 15 are arranged at predetermined intervals along the width of the warp yarns 2. The first nozzles 14 are included in a first nozzle group for spraying operation in the low-speed mode, and the second nozzles 15 are included in a second nozzle group for spraying operation in the normal mode. According to water spraying ranges which are different in supply pressure, the pitches of

the first nozzles 14 are smaller than those of the second nozzles 15. In Fig. 2, ellipses indicate water-spraying ranges of the nozzles 14 and 15. The ellipses indicating the water spraying ranges of the first nozzles overlap each other, and the ellipses indicating the water spraying ranges of the second nozzles overlap each other. The respective water spraying ranges of the nozzles 14 and 15 can be adjusted by adjusting the positions of a first screening plate 17 and a second screening plate 18, i.e., moistening adjusting members. The screening plates 17 and 18 are disposed between the first nozzles 14 and the path of the warp yarns 2 and between the second nozzles 15 and the path of the warp yarns 2, respectively. The screening plates 17 and 18 may be in the moving direction of the warp yarns 2, may be vertically translated or may be turned about an axis parallel to the width of the warp. The solenoid valves 10 and 11 are opened and closed to spray water 7 through the nozzles 14 and 15 and to stop spraying water 7 through the nozzles 14 and 15. The pressure of water 7 supplied to the nozzles 14 and 15 is regulated by the flow control valves 12 and 13. The pressure of water 7 for operation in the low-speed mode is low, and the pressure of water 7 for operation in the normal mode is high. The flow control valves 12 and 13 regulate the pressure of water 7 supplied to the nozzles 14 of the first nozzle group and the pressure of water 7 supplied to the nozzles 15 of the second nozzle group individually.

Practically, water 7 is hot water of 80 °C or above, but water 7 may be below 80 °C.

The squeezing unit 4 has a pair of squeezing rollers 19 disposed one on top of the other. The squeezing unit 4 squeezes the moistened warp yarns 2 moistened by the moistening unit 3. The moistened warp yarns 2 are squeezed between the squeezing rollers 19 to make moisture infiltrate fibers forming the warp yarns 2 and to moisten the warp yarns 2 uniformly by diffusing moisture from excessively moistened parts to insufficiently moistened parts the warp. When necessary, excessive moisture is squeezed off the warp yarns 2. The warp yarns 2 are guided by guide rollers 20 and 21 for traveling under the nozzles 14 and 15, and nipping between the pair of squeezing rollers 19 to the known sizing unit 5. Excessive water 7 squeezed off the warp yarns 2 is collected in a water box 34 and is discharged outside from the water box 34. The water box 34 may be provided with a weir to store a certain amount of water 7 therein. If the lower squeezing roller 19 is partly immersed in water 7 in the water box 34, water 7 wetting the lower squeezing roller 19 is transferred to the warp yarns 2.

After squeezing, the moistened warp yarns 2 are subjected to a sizing process by the sizing unit 5. The sizing unit 5 includes a size box 24 containing a size liquor 25, a pair of sizing rollers 22 partly immersed in the size liquor 25 in the

size box 24, and a pair of squeezing rollers 23. The surface of the size liquor 25 in the size box 24 is maintained at a fixed level by means of a weir or the like. The pair of sizing rollers 22 immerse the warp yarns 2 in the size liquor 25 for sizing and squeeze the sized warp yarns 2 to remove the excessive size liquor 25 from the warp yarns 2. While the warp yarns 2 are being sized and squeezed, part of the moisture supplied to the warp yarns 2 by the moistening unit 3 is replaced and mixed with the size liquor 25.

The drying unit 6 dries the sized warp yarns 2. The drying unit 6 includes a plurality of heating cylinders 26 and a plurality of guide rollers 27. The sized warp yarns 2 are brought into contact with the surfaces of the heating cylinders 26 for drying. The sized and dried warp yarns 2 are delivered through the guide rollers 27 and a dividing rod 28 to a slasher beam 29 and are wound on the slasher beam 29.

In the slasher 1, the warp yarns 2 travel sequentially through the moistening unit 3, the squeezing unit 4, the sizing unit 5 and the drying unit 6. The moistening unit 3 carries out a moistening process which sprays water 7 through the nozzles 14 and 15 on the warp yarns 2 to moisten the warp yarns 2. The squeezing unit 4 carries out a squeezing process which squeezes the moistened warp yarns 2 with the pair of squeezing rollers 19 to diffuse the moisture uniformly in the fibers forming the warp yarns 2 so that the warp yarns 2 are moistened

uniformly. The sizing unit 5 carries out a sizing process which sizes the warp yarns 2 properly by means of the pair of sizing rollers 22 and the pair of squeezing rollers 23. The drying unit 6 carries out a drying process which heats and dries the sized warp yarns 2. The warp yarns 2 thus sized and dried are separated by the dividing rod 28 and are wound on the slasher beam 29.

The moistening process sprays water 7 at high velocities in mist or droplets through the nozzles 14 or 15 on the warp yarns 2 to moisten the warp yarns 2 properly so that the warp yarns 2 may not be excessively moistened. Water 7 is sprayed at low speed through the first nozzles 14 while the slasher 1 is reduced in speed to stop or operating in the low-speed mode to spray water 7 on the warp yarns 2 moving at a low speed. Water 7 is sprayed through the second nozzles 15 while the slasher 1 is operating in the normal mode.

Subsequently, the moistened warp yarns 2 are squeezed by the pair of squeezing rollers 19 to moisten the warp yarns 2 uniformly and to make water infiltrate the fibers forming the warp yarns 2. Moisture infiltrated the warp yarns 2 is replaced and mixed with the size liquor 25 in the sizing process. Thus, the size liquor 25 is able to infiltrate the warp yarns 2 uniformly. Therefore, the warp yarns 2 can be effectively sized even if the sized warp yarns 2 have a low size percentage.

As mentioned above, water 7 is sprayed at low velocities

in mist or droplets through the first nozzles 14 on the warp yarns 2 moving at a low speed while the slasher 1 is reduced in speed to stop or operating in the low-speed mode. Water 7 is sprayed at high velocities in mist or droplets through the second nozzles 15 on the warp yarns 2 moving at a high speed while the slasher 1 is operating in the normal mode. Thus, the warp yarns 2 can be moistened while the slasher 1 is operating in the low-speed mode in the same moistening degree as that in which the warp yarns 2 are moistened while the slasher 1 is operating in the high-speed mode. Since water 7 is supplied to the first nozzle group including the first nozzles 14 and the second nozzle group including the second nozzles 15 at different pressures, respectively, water 7 is sprayed through the first nozzles 14 and the second nozzles 15 at different spraying pressures, respectively. Thus, water can be sprayed at an optimum water-spraying rate according to operating conditions including the moving speed of the warp yarns 2. The moisture percentage of the warp yarns 2 can be adjusted by adjusting the water spraying rate at which the first nozzles 14 or the second nozzles 15 spray water according to operating conditions including the moving speed, the number, the type and the yarn number count of the warp yarns 2. The water spraying rates at which the first nozzles 14 and the second nozzles 15 spray water can be adjusted by adjusting the flow control valves 12 and 13 for adjusting the pressure and

flow of water and/or by adjusting the sectional area of the nozzle holes of the nozzles 14 and hand drive substrate 15 moving needle of nozzle. The moisture percentage of the warp yarns 2 can be adjusted by adjusting the positions of the screening plates 17 and 18 and/or squeezing pressure exerted on the warp yarns 2 by the squeezing unit 4. The first nozzles 14 for the low-speed mode may be kept inoperative and only the second nozzles 15 and the screening plate 18 for the normal mode may be used. Thus, the water-spraying amount can be adjusted in a wide water spraying rate range. The nozzles 14 and 15 may spray water on the surfaces of the squeezing rollers 19. Water sprayed through the nozzles 14 and 15 and intercepted by the screening plates 17 and 18 is collected in a trough and is delivered outside or into the water box 34.

Figs. 3 and 4 show a mechanism including a hydraulic cylinder actuator 30 for vertically moving the second nozzles 15 of the moistening unit 3 relative to the warp yarns 2. According to the operating conditions, the spraying operation controller 16 adjusts the position of the second nozzles 15 by controlling the hydraulic cylinder actuator 30 and changes spraying angle (spraying range) by controlling the flow control valve 13 to adjust the pressure applied to water 7.

Generally, the pressure of water 7 is reduced to reduce spraying force at which water is sprayed through the second nozzles 15 when the slasher 1 is operating at a low operating

speed, so that water is sprayed through the second nozzles 15 in a small spraying angle. Consequently, some parts of the warp yarns 2 are not wetted with water sprayed through the second nozzles 15 and the warp yarn 2 cannot be uniformly moistened. Therefore, the spraying operation controller 16 controls the hydraulic cylinder actuator 16 to move the second nozzles 15 away from the warp yarns 2 to set the second nozzles 15 at an optimum height from the warp yarns 2 such that each of the second nozzles 15 is able to spray water in a necessary spraying range. Thus, the spraying operation controller 16 adjusts the distance between the warp yarns 2 and the second nozzles 15 according to the pressure applied to water 7 to maintain a fixed spraying range. The spraying range (area) in which the second nozzles 15 spray water is thus adjusted to moisten the warp yarns 2 uniformly.

Referring to Fig.5 showing a moistening unit 3 in another embodiment of the present invention, one (or plural) water spraying pipe 31 is arranged along the width of the warp yarns 2 above squeezing rollers 19, a plurality of nozzle-like holes 32 are formed at predetermined intervals in the water spraying pipe 31, and a movable screening plate 33 is disposed below the water spraying pipe 31. Water 7 supplied into the water spraying pipe 31 is discharged through the nozzle-like holes 32 onto the surface of the upper squeezing roller 19 and the water wetting the surface of the upper squeezing roller 19 is

transferred to the warp yarns 2. The moisture percentage of the warp yarns 2 thus moistened is adjusted by adjusting the flow of water supplied into the water spraying pipe 31 by a flow control valve 13 and the position of the screening plate 33 relative to the water spraying pipe 31 by moving horizontally or vertically.

As mentioned above, the moistening unit 3 uses hot water for moistening the warp yarns 2 when necessary. Hot water infiltrates the warp yarns 2 easily and the hot water moistening the warp yarns 2 evaporates more easily while the warp yarns 2 are moving into the sizing unit 5, so that the warp yarns 2 may not be excessively moistened. A trough may be disposed above the squeezing roller 19 instead of the water spraying pipe 31, and water (hot water) 7 may overflow the trough and may drop naturally onto the squeezing roller 19.

Although the invention has been described in its preferred embodiment with a certain degree of particularity, obviously many changes and variations are possible therein. It is therefore to be understood that the present invention may be practiced otherwise than as specifically described herein without departing from the scope and spirit thereof.